

A CLINICAL STUDY OF THE AMYLOLYTIC FERMENT IN URINE.

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In the year 1846 Majendie⁽¹⁾ and in 1863 Cohnheim⁽²⁾ demonstrated the fact that human urine contained a ferment which, under certain conditions, would reduce starch. In 1867 Foster⁽³⁾ showed that it was possible to dissociate the ferment from protein. He added alcohol to urine, filtered, washed the filtrate with alcohol, extracted with cold water, and filtered. The filtrate so obtained reduced starch, but gave none of the ordinary proteic reactions. He also pointed out that -

(1). The greater the dilution of the starch, the more rapidly does a given amount of ferment act.

(2). The presence of neutral salts has no appreciable effect on the ferment action.

(3). The addition of dilute acids or alkalies retards the ferment action which returns after neutralization, whereas the addition of strong acids or alkalies destroy the ferment.

(4). The ferment action is catalytic.

Foster believed the urine to be a channel for the excretion of a certain amount of ferment contained in the blood. Further, Foster was unable to find excess of the ferment in urine or blood in Diabetes, although

about this time it was suggested that Diabetes was due to excess of the ferment in the blood.

In 1905 Clark⁽⁶⁾ showed the presence of the ferment in urine. He pointed out that it acted best in an almost neutral medium and was destroyed by boiling. In Diabetic urine he was unable to find any ferment and consequently came to the conclusion that Diabetes might be due to retention of the ferment in the blood, but he brings forward nothing to prove it. This ferment has been called Diastase by the various observers.

In 1908 Wohlgenuth⁽⁶⁾ put forward a method of quantitative estimation of the amylolytic ferment. He says that less Diastase is excreted by a damaged kidney, and this he confirms by examining the urine from cases of Nephritis, where he found the ferment to be always less than normal. As a means of finding out if one kidney is diseased he suggests estimating the amount of Diastase in samples of urine obtained by ureteric catheterization.

In April 1913, The Journal of Quarterly Medicine published an interesting and highly instructive paper by Dudley Corbett⁽⁶⁾ on the same subject. He confirmed practically all the observations made by Wohlgenuth.

What struck me in studying most of the literature on the subject, was the fact that the different observers

seemed to confine their attention to cases known to be suffering from Diabetes, kidney or pancreatic disease. Corbett, however, has been much more liberal in his choice of cases. To eliminate this possible source of error I examined indiscriminately the urine of a large number of cases met with in the ordinary course of Hospital practice. I then classified the results so obtained under the various systems.

Technique.

I have followed as nearly as possible the exact technique of Wohlgemuth⁽⁵⁾ and Corbett⁽⁶⁾, in order that I might be able to compare my results with those obtained by these observers.

Solutions required -

- (1). 3 c.cms. of Urine.
- (2). Normal saline.
- (3). 0.1% starch solution (Kahlbaum) in distilled water. This I prepared fresh every third day by boiling 500 c.cms. of distilled water in a flask, gradually adding 5 mgr. of starch and stirring all the time.
- (4). 1/50 N. Iodine solution in distilled water.

This I prepared freshly each time it was required by diluting 1/10 N. Iodine solution with distilled water.

I took ten test-tubes, which I thoroughly cleansed, rinsed with distilled water and dried in a sterilizer. To each tube I added the following quantity of urine respectively - .6 cc., .5 cc., .4 cc., .3 cc., .2 cc., .1 cc., .09 cc., .08 cc., .07 cc., .06 cc.

The first six measurements I made with a pipette graduated in hundredths. The last four I measured with the same pipette, but I previously diluted the urine 1 in 10 with normal saline. On each tube was marked the amount of urine, which it contained.

Having measured out the urine as stated, I made the amount in each tube up to 1 cc. by addition of normal saline. To each tube I then added 2 cc. of 0.1% starch solution and carefully shook the contents. I now placed the tubes in a water bath, which was kept at a temperature between 38° and 39°C. At the end of half an hour I took them out and placed them in cold water for three minutes to stop the ferment action. To each tube I added two drops of 1/50 N. Iodine solution. The colours so obtained passing from the .6 cc. tube to the .09 cc. tube merged from a yellow to a dark blue. I noted the tube in which the blue tint first appeared.

This by Corbett⁽⁶⁾ has been termed the "limit" tube and it indicates the tube in which the first trace of undigested starch has been found. The Diastase content or "D" value of the urine is calculated as follows: -

Suppose the "limit" tube to be that containing .2 cc. urine, then the tube containing .3 cc. urine has had all its starch digested into sugar. .3 cc. urine will digest 2 cc. 1% starch solution in half an hour. Therefore 1 cc. urine will digest $\frac{2}{.3}$ - 6.6 cc. starch solution in half an hour, or

"D" - 6.6 units.

In carrying out this work, I used a zinc stand, which held five rows of test tubes, each row holding ten tubes. I was thus able to examine five different urines at the same time.

I first made the following general observations with regard to the conditions under which the ferment acts: -

1. Action of Heat.

- (a) The ferment acts best at a temperature between 38° and 39° C.
 - (b) When urine is heated to boiling point the ferment is killed.
 - (c).When urine is kept at a temperature of 58° C.
- I noticed that after the first eighteen

minutes the action of the ferment gradually became less, but it was not destroyed until kept at this temperature for one hour.

2. The ferment can be extracted from the urine with alcohol. This I was able to do by following the method adopted by Foster,⁽³⁾ which I have already referred to.
3. The amount of Diastase in a 24 hours' specimen of a normal individual varies within very narrow limits, and for a given case is an almost constant factor. It is apparently uninfluenced by the quantity of urine passed, by the reaction, i.e. whether alkaline or acid, or by the nature of the food taken. The last named item refers only to the ordinary variations in diet. Corbett⁽⁶⁾ has shown that the "D" value was increased from 4 to 20 in the urine of a child to whom starchy food had been given. I arrived at the above conclusions after examining the urine from 55 normal cases - each urine was examined on three different occasions. I found the normal limits to range between 6.6 and 40.
4. Influence of the presence of albumen. For this purpose I drew off a small quantity of blood from

the vein of an apparently normal individual, who had nothing abnormal in his urine. I centrifuged this blood and obtained the serum, which I placed in a water bath at 62° C. for 1 hour. This procedure served to destroy the ferment present in the blood serum, but did not coagulate any of the albumen, which does not coagulate until a temperature of 73° C. is reached. I made sure that all the ferment was destroyed by incubating various strengths of the serum with 0.1% starch solution at 38° C. for half an hour. In all the tubes the starch was unchanged. I now took some urine from the patient whose blood was used and divided it into two portions A & B. To the portion B. I added the prepared blood serum in the proportion of twelve parts per thousand. I estimated the "D" values of A & B in the ordinary way with the following result -

Urine A. - "D" value - 20

Urine B. - "D" value - 20.

thus demonstrating that the presence of "ferment-free" albumen, when added to normal blood has no influence upon the "D" value.

I repeated the experiment, using serum in which the ferment had not been killed and got a similar result. These experiments showed that

albumen has no influence on the ferment action.

5. Influence of the presence of Blood. I took urine from a normal patient and added blood from the same patient until the urine was markedly tinged. I then estimated the "D" value with the following result.

"D" value of original urine - 10

"D" value of urine with blood added - 20.

This demonstrates that blood has an accelerating action on the amylolytic activity of urine.

6. Influence of the presence of sugar and acetone. In this case I took a sample of normal urine and divided it into two portions A and B. To portion B. I added glucose in proportion of 4% and also a few drops of acetone.

On comparing the "D" values of A & B I found them both to be the same. From this experiment I concluded that the addition of sugar and acetone had no effect on the activity of the ferment.

1. DISEASES OF NERVOUS SYSTEM.

1. G.B. Hysteria.

Urine about 80 oz. per diem. No abnormal
constituents.

"D" value - 10.

2. W.L. Epilepsy.

Urine normal.

"D" value - 20.

3. K.A. General paralysis of the Insane.

Urine normal.

"D" value - 10.

4. G.H. Acute Anterior Poliomyelitis - convalescent.

Urine normal.

"D" value - 20.

5. K.D. Neurasthenia.

Urine contained a trace of albumen.

No casts.

"D" value - 3.3

6. H.H. Tabes Dorsalis.

Urine contained a small amount of
albumen. No casts.

"D" value - 2.8

7. R.S. Tabès Dorsalis.
Urine normal.
"D" value - 20.
8. R.M. Cerebral Embolism
Urine normal
"D" value - 20.
9. M.R. Cerebral Syphilis
Urine normal.
"D" value - 10.
10. W.S. Concussion
Urine normal
"D" value - 28.8
11. C.E. Hemiplegia which subsequent Post Mortem
shewed to be due to a large tumour in
Pons.
Urine normal
"D" value - 20.
12. G.K. Peripheral Neuritis.
Urine normal
"D" value - 10.
13. S.M. Beri-Beri.
Urine contained small quantity of
albumen. No casts.
"D" value - 4.

14. S.F. Syringo-Myelia.

Urine normal.

"D" value - 22.2.

From these cases I have concluded that the "D" value of the urine is unaffected by the common diseases of the Nervous System. In cases 5, 6, and 13 the "D" value is lowered, but in these cases there is reason to believe that there is some slight impairment of the kidney functions.

2. DISEASES OF THE RESPIRATORY SYSTEM.

1. W.G. Bronchitis.

Urine normal.

"D" value - 20.

2. M.R. Bronchitis.

Urine normal.

"D" value - 33.3.

3. S.F. Phthisis.

Urine normal.

"D" value - 10.

4. G.R. Phthisis.

Urine normal.

"D" value - 10.

5. R.M. Phthisis.
Urine contained a fair amount of
albumen. No casts.
"D" value - 3.3.
6. F.H. Phthisis.
Urine contained a small amount of
albumen and hyaline casts.
"D" value - 2.8.
7. M.H. Sarcoma of lung.
Urine normal.
"D" value - 22.2.
8. S.R. Pleurisy with effusion.
Urine normal.
"D" value - 20.
9. T.M. Bronchiectasis.
Urine contained a trace of albumen.
"D" value - 3.3.
10. T.H. Lobar pneumonia.
Urine normal.
"D" value - 20 before the
crisis.
"D" value - 22.2 after the
crisis.

11. W.M. Broncho-pneumonia.
 Urine normal
 "D" value - 10.

12. W.S. Broncho-pneumonia.
 Urine normal.
 "D" value - 22.2.

Here again the "D" value does not appear to be abnormal except in those cases where there is reason to suspect some slight kidney trouble.

3. DISEASES OF STOMACH AND INTESTINES.

1. M.G. Alcoholic Gastritis.
 Urine normal.
 "D" value - 20.

2. R.L. Chronic Dyspepsia.
 Urine normal.
 "D" value - 10.

3. M.R. Gastric Ulcer.
 Urine normal.
 "D" value - 6.6.

4. F.M. Gastric Ulcer.
 Urine normal.
 "D" value - 22.2.

5. R.E. Duodenal Ulcer
Urine normal.
"D" value - 10.
6. P.S. Carcinoma of Pylorus, confirmed by P.M.
Urine normal.
"D" value - 20.
7. W.S. Carcinoma of stomach. P.M. showed
secondary growths in omentum and head
of pancreas.
Urine normal.
"D" value - 100.
In this case before death
involvement of the pancreas was not
suspected.
8. W.G. Carcinoma of lesser curvature
Urine normal.
"D" value - 20.
9. F.R. Duodenal ulcer.
Urine normal.
"D" value - 22.2.

10. T.W. Simple ulceration of Colon.
Urine normal.
"D" value - 10.
11. L.E. Carcinoma of Rectum.
Urine normal.
"D" value - 20.
12. S.F. Carcinoma of Rectum.
Urine normal
"D" value - 22.2.
13. R.H. Carcinoma of Pelvic Colon.
Urine normal
"D" value - 10.
14. E.M. Haemorrhoids.
Urine normal.
"D" value - 10.

In this group of cases the "D" values of the urines were within the normal limits, except in the case of No. 7, and in that particular case the pancreas was found to have been affected.

4. DISEASES OF THE BLOOD AND BLOOD-FORMING ORGANS.

1. S.P. Pernicious anaemia.
Urine normal.
"D" value - 20.
2. M.R. Pernicious anaemia.
Urine normal.
"D" value - 22.2.
3. G.H. Polycythaemia.
Urine normal.
"D" value - 10.
4. W.N. Secondary anaemia.
Urine normal.
"D" value - 22.2.

In this group of cases the "D" value of the urine appears to have been unaffected.

5. DISEASES OF THE LIVER.

1. A.R. Alcoholic Cirrhosis. No jaundice.
Urine normal.
"D" value - 20.
2. W.I. Alcoholic Cirrhosis with jaundice.
Urine contained bile, but no albumen.
"D" value - 22.2.

3. V.H. Carcinoma (Secondary). Marked jaundice.

P.M. showed pancreas normal.

Urine normal.

"D" value - 10.

4. W.H. Abscess (Tropical).

Urine normal.

"D" value - 33.3.

In these cases the "D" values also lay within the normal limits.

6. ACUTE CONDITION GIVING RISE TO HIGH TEMPERATURES.

1. G.M. Typhoid Fever.

First week - temperature 104° F.

"D" value - 66.6.

Fourth week - temperature 97° F.

"D" value - 20.

2. W.P. Acute Appendicitis, no general peritonitis.

Temperature before operation 102° F.

"D" value - 100.

Ten days later - temperature normal.

"D" value - 22.2.

3. R.P. Acute Appendicitis with general peritonitis.
Temperature before operation 102.5° F.
"D" value - 66.6.
Three weeks later, temperature normal.
"D" value - 33.3.
4. M.P. Acute Appendicitis with general peritonitis
Temperature before operation 103° F.
"D" value - 20.
Patient died three days after operation.
5. C.D. Acute Arthritis. Temperature 104°.
"D" value - 100.
6. J.D. Acute Osteomyelitis.
Temperature 103° F.
"D" value - 22.2.
7. H.M. Acute Osteomyelitis.
Temperature 102.5°F.
"D" value - 66.6.
One week later temperature normal.
"D" value - 20.

8. G.W. Septicaemia from septic finger.
Temperature 103° F.
"D" value - 22.2.
9. W.R. Acute Rheumatism.
Temperature 103° F.
"D" value - 100.
One week later temperature normal.
"D" value - 33.3.
10. M.S. Acute Rheumatism.
Temperature 102.5° F.
"D" value 66.6.
One week later temperature normal.
"D" value - 20.
11. A.S. Acute pyelitis.
Temperature 104° F. Urine contained
Pus, blood and albumen.
"D" value - 5.
12. S.T. Acute Pyelitis.
Temperature 105° F. Pus and albumen in
urine.
"D" value - 20.

13. W.L. Influenza.
Temperature 102° F.
"D" value - 66.6.
14. L.G. Influenza.
Temperature 102.5° F.
"D" value - 50.
15. R.L. Erysipelas.
Temperature 104° F.
"D" value - 100.
16. S.O. Erysipelas.
Temperature 103° F.
"D" value - 66.6.
17. D.K. Acute miliary tuberculosis.
Temperature swinging.
"D" value - 5.

From these cases I have concluded that there is a rise in the "D" value of the urine in the majority of such acute cases. In the two of the above cases where the kidney was chiefly involved, the reading was subnormal and normal. This may be a probable explanation of the normal and subnormal "D" values got in some acute conditions if one assumes that the kidney structure has been slightly damaged.

7. DISEASES OF THE CARDIO-VASCULAR SYSTEM.

1. C.L. Aortic stenosis and incompetence, and mitral disease. Enlarged liver, marked dropsy, case died. Urine contained some albumen.
"D" value - 6.6.
2. A.D. Myocarditis, marked breach of compensation. Albumen in urine.
"D" value - 20.
One month later when compensation was restored.
"D" value - 22.2.
3. S.T. Mitral incompetence.
Compensation broken down.
Albumen in urine.
"D" value - 10.
Two weeks later when compensation was restored.
"D" value - 10.
4. R.T. Mitral stenosis.
Compensation broken down.
Albumen in urine.
"D" value - 5.
One month later when compensation was restored.
"D" value - 33.3.

5. T.H. Mitral stenosis and incompetence.

Marked breach of compensation.

Considerable amount of albumen in urine.

"D" value - 10.

Three weeks later when compensation was restored and albumen had disappeared from urine.

"D" value - 40.

6. W.E. Mitral incompetence.

Breach of compensation

Albumen in urine.

"D" value - 6.6.

Two weeks later when compensation was restored and albumen had disappeared from urine

"D" value - 22.2.

7. E.K. Aortic incompetence

Compensation broken down

Albumen and blood in urine

"D" value - 20.

Six weeks later when compensation was restored and albumen had disappeared.

"D" value - 33.3.

8. E.O. Aortic stenosis.

Compensation broken down.

Blood and albumen in urine

"D" value - 10.

Three weeks later when compensation was
restored and urine normal

"D" value - 20.

9. H.P. Aortic stenosis and incompetence

Compensation broken down

Albumen in urine

"D" value - 6.6.

Eight weeks later when compensation was
restored and urine normal

"D" value - 33.3.

10. H.I. Mitral incompetence

Compensation broken down

Blood and albumen in urine

"D" value - 10.

Three weeks later when compensation was
restored and urine normal

"D" value - 22.2.

11. G.K. Aneurysm of Aorta.

Urine normal

"D" value - 33.3.

12. S.F. Aneurysm of Aorta

Urine normal

"D" value - 20.

13. R.O. Acute dilatation of heart.

Urine normal.

"D" value - 22.2.

14. H.M. Heart Block.

Urine normal.

"D" value - 10.

In the majority of these cases, where there was a breach of compensation and where there was reason to suspect that the kidney was in a state of passive congestion, we may observe that the "D" value was either subnormal or at least a low normal. Furthermore, when compensation had been restored the "D" value rose. From these facts I have concluded that during the period of breach of compensation the "D" value gives us an indication of the amount of impairment of the kidney function, provided that we make allowance for the amount by which the "D" value has been raised by the blood and albumen present. For, as I will show later, in cases where blood and albumen are present the "D" value of the urine is raised.

8. DISEASES OF THE RENAL SYSTEM.

1. P.S. Cystitis due to stone in bladder.

Blood, pus and albumen in urine.

Catheterization of ureters showed kidneys to be normal.

(a). Specimen from right ureter (no blood or albumen.)

"D" value - 20.

(b). Specimen from left ureter (no blood or albumen).

"D" value - 20.

(c). Urine from bladder (Pus, blood and albumen)

"D" value - 66.6.

2. W.O. Cystitis - cause unknown.

Pus, blood and albumen in urine.

Catheterization of ureters showed kidneys to be apparently normal. X Ray plates of kidneys negative.

(a). Specimen from right ureter (no blood or albumen).

"D" value - 10.

(b). Specimen from left ureter (no blood or albumen).

"D" value - 10.

(c). Specimen from bladder (pus, blood and albumen).

"D" value - 50.

3. S.M. Tuberculosis of left kidney.

Diagnosis verified by laparotomy and left kidney excised.

Specimen obtained by catheterization of left ureter.

"D" value - 6.6

Specimen obtained by catheterization of right Ureter

"D" value - 33.3.

4. E.S. Tuberculosis of right kidney.

Diagnosis verified by laparotomy and right kidney excised.

Specimen obtained by catheterization of right ureter.

"D" value - 10.

Specimen obtained by catheterization of left ureter

"D" value - 66.6.

5. K.M. Chronic Interstitial Nephritis.

Small amount of albumen present

"D" value - 5.

6. I.Mc.F. Chronic Nephritis.

Small amount of albumen present at times.

No albumen present on day on which "D" value was estimated.

"D" value - 2.

7. C.Y. Chronic tubular Nephritis.

Ten oz. of urine passed in 24 hours.

Considerable amount of albumen.

Granular and fatty casts.

"D" value - 10.

8. F.E. Chronic Nephritis.

Very little albumen present.

Thirty oz. of urine passed in 24 hours.

"D" value - 4.

9. A.W. Chronic Nephritis.

Large amount of albumen present.

"D" value - 20.

10. S.B. Chronic Nephritis.

Considerable amount of albumen present.

"D" value - 5.

11. B.S. Chronic Nephritis.

Large amount of albumen present.

"D" value - 22.2.

12. E.McM. Chronic Nephritis.

Considerable amount of albumen present.

"D" value - 6.6

13. G.F. Chronic Nephritis.

Large amount of albumen present.

"D" value - 20.

14. R.P. Chronic Nephritis.

Only a trace of albumen present.

"D" value - 3.3.

15. M.Mc.F. Chronic Nephritis.

Very small quantity of albumen present.

"D" value - 4.

16. W.E. Chronic Nephritis.

No albumen present at time of examination.

No Diastase could be detected in this urine,
notwithstanding the fact that the examination
was carried out on three different occasions.

17. M.B. Chronic Nephritis.

Large quantity of albumen present.

"D" value - 22.2.

18. G. Mc.N. Chronic Nephritis.

Large quantity of albumen present.

"D" value - 20.

On looking at the first two cases in this series, and on comparing the "D" value of the ureter specimens with that of the urine from the bladder, one can see how considerable is the increase which takes place in the "D" value when blood and albumen are present in the urine, as is the case in the bladder specimens from both of these cases.

It was pointed out by Pozerski⁽⁷⁾ in 1902 and by Wohlgemuth⁽⁸⁾ in 1911 that blood and various organ extracts have a marked accelerating action on the amylolytic activity of pancreatic juice and saliva. Corbett pointed out in 1913 that blood has an accelerating influence on the amylolytic activity of urine. I may add that from other cases examined I have come to the conclusion that one requires to have a fair amount of blood present before one gets any obvious acceleration in the ferment action. Further it is well to bear in mind that cases do exist (pathologically) where the "D" value of the blood is considerably higher than that of the urine. In such cases the effect of a haemorrhage from the bladder or kidney would be similar to that got by mixing two fluids of different "D" values. The mixture so obtained would give a mean "D" value, which would be greater than that of the fluid which had the lesser "D" value in proportion to the amount of the other fluid added. Cases 3 and 4 illustrate the use of the "D" value as an index for

comparing the functioning capacity of either kidney. When a kidney is diseased the excretion of Diastase is not properly carried out and accordingly the "D" value is diminished. I have quoted two cases which I have had the opportunity of examining. In both of these the urine from the diseased kidney showed a marked fall in the "D" value.

I believe this method of examining ureter specimens, in cases where one kidney is suspected of being diseased, to be more efficient than those methods more commonly employed viz. Methylene Blue, Phloridzin etc. The technique is simple and the results so obtained are definite.

Cases 5 to 18 are a series of Chronic Nephritis. Two of these cases had no albumen in the urine at the time of examination. In one Diastase was entirely absent and in the other the "D" value was much diminished. Four cases show a subnormal "D" value. In these cases the amount of albumen was very small.

The remaining eight cases show a subnormal or normal "D" value. In these cases there was a large amount of albumen present. From these cases I have concluded that in Chronic Nephritis the "D" value of the urine is subnormal or nil. The presence however of albumen raises the "D" value in proportion to the amount of albumen present. Where the albumen is small in amount the "D"

value will still remain subnormal, but where the albumen is large in amount it may be increased, so that the reading appears to be normal.

Nearly all observers have found the "D" value to be high in albuminous urines. It is difficult to explain why this fact should be so. I have already shown that when one adds a "ferment-free" albumen or an albumen containing ferment to a normal urine, that there is no appreciable change in the "D" value. I consider the theory given by Corbett to be the most acceptable. He says that the damage done to the kidney may be equally severe in cases with much or little albumen, and that the presence of much albumen simply indicates an increased permeability of the kidney. He therefore concludes that where the renal cells are permeable to a complex mixture like albumen, they should more readily allow the passage of a simple colloid like Diastase.

9. DIABETES.

1. F.J.R. Diabetes Mellitus.

Sugar 3%. Quantity of urine in 24 hours was about 120 oz. No Acetone or Diacetic Acid. One week before death quantity of urine in 24 hours was reduced to 40 oz. and sugar was entirely absent. Post Mortem examination shewed extensive fibrosis of the pancreas which was confirmed by microscopical

examination. Nothing else abnormal was found beyond a slightly fatty liver. The "D" value was estimated about every ten days for over two months, and although latterly the sugar disappeared and quantity of urine became less, the "D" value never went below 2 or above 2.8. The "D" value was unaltered after starving patient for a period of 24 hours.

2. F.B. Diabetes Mellitus.

Small quantity of sugar present.

Readings on three different occasions were

"D" value - 6.6

"D" value - 4

"D" value - 4

3. M.T. Diabetes Mellitus.

Sugar 3%. No Acetone or Diacetic Acid.

Before death sugar disappeared from urine.

Post Mortem shewed abscesses in lungs.

Diastase estimated every ten days for 8 weeks.

Practically no variation.

"D" value - 2.8

4. S.G. Diabetes Mellitus.

On admission patient was passing 180 oz. of

urine in 24 hours. Sugar $7\frac{3}{4}\%$. Diastase was estimated every week for eleven weeks, during which time the patient became worse, the amount of urine in 24 hours fell to 100 oz. and the sugar to 2%. On two occasions no Diastase could be found. On the other days it varied between 2 and 2.2.

5. W. Mc.I. Diabetes Mellitus and Phthisis.

Sugar 6%. No Acetone or Diacetic Acid. Patient died. Post Mortem shewed nothing beyond advanced Phthisis. "D" value estimated on four different occasions varied between 3.3 and 5.

From this series of cases it can be seen that the "D" values in Diabetes are considerably diminished or absent. In Case 2 however it may be noticed that on one occasion it rose to 6.6. Most observers have found the "D" value considerably diminished or nil in Diabetes. The quantity of urine passed or the percentage of sugar present does not appear to have much influence on the "D" value.

Case 1 is very interesting from the fact that at Post Mortem examination an interstitial pancreatitis was found. As most observers have found that there is

an enormous increase in the output of Diastase in chronic pancreatitis one might have expected to find the "D" value increased in this particular case. On the other hand it always remained subnormal. As far as I have been able to find out, there appears to be no case recorded where a high "D" value has been obtained in Diabetes, and it seems very improbable that in all the cases of Diabetes examined and reported upon by various observers, none should have had a pancreatic lesion.

The association between the pancreas and Diabetes is still very obscure, although recent light has been thrown on the subject by Starling and Knowlton⁽⁹⁾. They have shewn that in normal blood there is a hormone which is elaborated by the pancreas, and which assists the muscle to break up sugar. This hormone is absent in the blood of diabetic patients, but whether this is primary or secondary to any lesion in the pancreas has not yet been shewn.

With regard to Diabetes Insipidus, I have been unable to collect any cases. Straus⁽¹⁰⁾ reports two cases in which he found no Diastase. Rosenthal⁽¹¹⁾ reports one case where it was usually absent, but occasionally present in very small quantities. Benczur⁽¹²⁾ reports one case where he found it present in the normal amount.

10. DISEASES OF THE PANCREAS.

Under this heading I have only four cases to record. Of these one has been fully discussed under Diabetes, and another mentioned in dealing with diseases of the Alimentary System.

1. F.J.R. Diabetes and Pancreatitis - already mentioned.

"D" value subnormal.

2. W.S. Carcinoma of Stomach involving head of pancreas - already mentioned.

"D" value - 100.

3. L. Mc.C. Carcinoma of head of Pancreas.

Urine contained a large amount of Bile.

"D" value - 33.3.

4. F.M.W. Chronic Interstitial Pancreatitis.

"D" value - 200.

Estimated on four different occasions and found to vary practically nothing.

Cases 2 and 4 show high readings. Case 3 shews a normal reading, this however may be due to the fact that there was a large amount of bile present in the urine. Wohlgemuth has shewn that bile in small amounts accelerates amylolytic action, whereas in large amounts it inhibits it.

The opinion of the majority of workers on this subject is that there is a considerable increase in the "D" value of the urine in pancreatic disease. Some of Corbett's figures reach as high as 400 and 500.

11. MISCELLANEOUS CASES.

1. R.J. Pelvic Sinuses.
 Urine normal.
 "D" value - 28.8.
2. J.L. Secondary Syphilis.
 Urine normal.
 "D" value - 6.6.
3. A.W. Chronic Rheumatism.
 Urine normal.
 "D" value - 20.
4. F. Mc.K. Tertiary Syphilis.
 "D" value - 6.6.
5. M.H. Enlarged Bursa.
 "D" value - 20.
6. F.M. Enlarged Prostate.
 "D" value - 33.3.

7. W.S.H. Exophthalmic Goitre.
 "D" value - 10.
8. P.H. Acromegaly.
 "D" value - 20.
9. F.F. Caisson Disease.
 "D" value - 6.6
10. S.R.N. Mediastinal Sarcoma.
 "D" value - 22.2.
11. G.H.R. Rheumatoid Arthritis.
 "D" value - 20.
12. M.S.R. Rheumatoid Arthritis.
 "D" value - 33.3.

These cases are all within the normal limits.

CONCLUSIONS.

1. An amylolytic ferment is excreted in the urine of normal individuals.
2. The amount of Diastase in the twenty-four hour specimen of a normal individual as estimated by Wohlge-muth's method varies within very narrow limits and for a given case is an almost constant factor. The normal limits are between 6.6 and 40, the average being between 6.6 and 33.3. Each unit represents the amount of ferment in 1 cc. of urine which converts 2 cc. of 0.1% starch solution into dextrine in half an hour at 38° C.
3. Only in cases where the amount of urine passed in twenty-four hours is over 3,000 cc. or under 500 cc. can the factors of dilution or concentration have any appreciable influence, and in such cases due allowance should be made in interpreting the "D" value.
4. No pathological constituents of the urine have any effect upon the "D" value except blood and albumen. In Nephritis, if twenty-four hour specimens are examined the "D" value will be found to be subnormal or absent, except when large quantities of albumen are present.
6. A high "D" value is obtained in cases where there is much albumen in the urine. This is probably due to the fact that when a large quantity of albumen is being

excreted, the kidney is more permeable and consequently more ferment is allowed to pass through. In such cases due allowance should be made in interpreting the "D" values.

7. In kidney conditions other than Nephritis the estimation of the "D" value of Ureter specimens forms a reliable method of comparing the functioning capacity of the kidneys.

8. In Diabetes the "D" value is very low or nil.

9. In conditions with high temperatures the "D" value may be raised, but as a rule does not go above 100.

10. High readings are obtained in cases where the pancreas is diseased.

11. In cardiac cases where a breach of compensation has occurred, the "D" value is either subnormal or a low normal. Allowance must be made in those cases in which albumen is present.

(For References see next page)

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